Modelling Human-Awareness for Ambient Agents: A Human Mindreading Perspective

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Summary

The emergence of Information and Communication Technologies (ICT) has become visible in our daily life and steps have been taken by the researchers and investigators to achieve the vision of making these technologies disappear into the environment using advanced technology and computing thus creating an ergonomic space for the inhabitant, encompassing an active living space around us. This vision has several names and definitions that closely resemble each other; it can be called *ubiquitous computing*, *pervasive computing*, or *ambient intelligence* (AmI). AmI makes distributed wired and wireless computing and communication disappear into the background and puts users to the foreground. Its ultimate goal is to improve the quality of our life by a reliable and secure interaction with our social and material environment. To achieve this goal, knowledge about humans and their functioning is an important factor, because devices in the environment possessing such knowledge can show a more human-like understanding.

To bring this goal to realization, devices needs to be built possessing knowledge about humans, devices that are able to perform a more in-depth analysis of the human's functioning. For this, we need the assistance of human-directed disciplines such as cognitive science, psychology, neuroscience and biomedical sciences that develop models for many different aspects of human's functioning. If such models of human processes are represented in a formal and computational format, and incorporated in these devices, then such devices can be made more user-friendly and more responsive to humans. The integration of these models within the AmI applications is becoming more widely known as *human-aware ambient agent modeling*. In this thesis, the aspect that has been taken as a point of departure to model *ambient agents* is *mindreading* or *Theory of Mind* (ToM): an ability to attribute mental states such as, beliefs, intentions, desires, pretending, knowledge, emotion etc to others and to understand that those states may be similar or different from one's own.

Two philosophical perspectives on having a Theory of Mind are *Simulation Theory* and *Theory Theory*. In the first perspective it is assumed that mindreading takes place by using the facilities involving the own mental states that are counterparts of the states attributed to the other person. For example, the state of feeling pain oneself is used in

the process to determine whether the other person has pain. The second perspective is based on reasoning using knowledge about relationships between cognitive states and observed behavior. An example of such a pattern is: 'I hear that the person says 'ouch!'. Having pain causes saying 'ouch!'. Therefore the person has pain'.

Throughout this thesis models are investigated both from Simulation Theory and Theory Theory perspective involving cognitive and affective aspects and the interaction between these two states of humans. These models have been integrated into ambient agent models in order to bring on human-awareness for AmI applications. To explore the applicability of the approach proposed in this thesis, it has been applied in different specializations addressing integrated approaches to, for example, reasoning, emotion generation and reading, emotion contagion, believing, desiring, feeling, decision making, and attention.

This thesis is mainly divided into three parts (excluding part I and part V that describe Introduction and Discussion and Future Work respectively), which comprise in total 11 chapters. Some of the ambient agent models designed in those chapters follow the Theory Theory approach of Theory of Mind, some choose the Simulation Theory approach, while some other take a unified approach integrating Theory Theory (TT) and Simulation Theory (ST) approaches. On the other hand, while most of the proposed models have been integrated into an ambient agent model, still there are a few models which have been left to be integrated as future work.